

motor generator, and a control circuit for controlling said inverter;

said hybrid car further characterized in that;

said motor generator is driven by battery power to start said internal combustion engine, and, after said internal combustion engine has started, said battery is charged by the generator mode operation of said motor generator using the power of said internal combustion engine;

wherein a step-down chopper circuit is provided between the battery and the inverter, and step-down control is provided to ensure that the power generation voltage will reach the level of the battery charging voltage through a step-down chopper circuit.

16. (new) A power generator in a hybrid car comprising:

a motor generator mechanically connected with the crank shaft of an internal combustion engine for driving a car wherein said internal combustion engine is started by electric power supplied by a battery and power is generated by rotation from said internal combustion engine to charge a battery, an inverter for controlling the drive and power generation of a motor generator, and a control circuit for controlling said inverter;

said hybrid car further characterized in that;

said motor generator is driven by battery power to start said internal combustion engine, and, after said internal

combustion engine has started, said battery is charged by the generator mode operation of said motor generator using the power of said internal combustion engine;

wherein a step-up chopper circuit is provided on the output side of the battery, and, when the motor generator is started by the electric power of the battery, the battery voltage is stepped up to drive said motor generator and to start said internal combustion engine.

17. (new) A power generator in a hybrid car according to Claim 15 characterized in that said motor generator is a permanent magnet field motor generator having its rotor equipped with a permanent magnet and constituting a field pole or a jaw type magnetic pole synchronous motor generator having its rotor with jaw type magnetic pole field, wherein the weak field rate is 1 to less than 4.

18. (new) A power generator in a hybrid car according to Claim 16 characterized in that said motor generator is a permanent magnet field motor generator having its rotor equipped with a permanent magnet and constituting a field pole or a jaw type magnetic pole synchronous motor generator having its rotor with jaw type magnetic pole field, wherein the weak field rate is 1 to less than 4.

19. (new) A power generator in a hybrid car according to Claim 15 characterized in that said motor generator is an induction motor generator having its rotor equipped with multiple secondary conductors and the weak field rate is 1 to 3 or more.

20. (new) A power generator in a hybrid car according to Claim 16 characterized in that said motor generator is an induction motor generator having its rotor equipped with multiple secondary conductors and the weak field rate is 1 to 3 or more.

21. (new) A power generator in a hybrid car according to Claim 15 characterized in that said battery comprises an auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the

internal combustion engine after said internal combustion engine has started;

wherein, if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage control is performed by said step-down chopper circuit to step down said voltage until it agrees with the charging voltage of said main battery.

22. (new) A power generator in a hybrid car according to Claim 16 characterized in that said battery comprises an auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage control is performed by said step-down chopper circuit to step

down said voltage until it agrees with the charging voltage of said main battery.

23. (new) A power generator in a hybrid car according to Claim 17 characterized in that said battery comprises an auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage control is performed by said step-down chopper circuit to step down said voltage until it agrees with the charging voltage of said main battery.

24. (new) A power generator in a hybrid car according to Claim 19 characterized in that said battery comprises an

auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage control is performed by said step-down chopper circuit to step down said voltage until it agrees with the charging voltage of said main battery.

25. (new) A motor generator control method for a hybrid car comprising:

a motor generator mechanically connected with the crank shaft of an internal combustion engine for driving a car wherein said internal combustion engine is started by electric power supplied by a battery and power is generated by rotation from said internal combustion engine to charge a battery, an

inverter for controlling the drive and power generation of a motor generator, and a control circuit for controlling said inverter;

said hybrid car further characterized in that;

if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage step-down control is performed by a step-down chopper circuit to step down said voltage until it agrees with the charging voltage of said main battery.

26. (new) A motor generator control method for a hybrid car according to Claim 25 characterized in that said battery is charged by operation of said motor generator in the generation mode wherein;

if the voltage generated by said motor generator is greater than charging voltage of said main battery, said voltage is stepped down by said step-down chopper circuit;

at the same time, and the current phase of the stator winding of said motor generator is controlled to get weak field component by armature reaction magnetic flux to ensure that said generated voltage agrees with said battery charging voltage.

27. (new) A motor generator control method for a hybrid car comprising:

a motor generator mechanically connected with the crank shaft of an internal combustion engine for driving a car wherein said internal combustion engine is started by electric power supplied by a battery and power is generated by rotation from said internal combustion engine to charge a battery, an inverter for controlling the drive and power generation of a motor generator, and a control circuit for controlling said inverter;

said hybrid car further characterized in that;

when said motor generator is started by electric power of said battery, a step-up chopper circuit is provided on the output side of said battery to step up said battery voltage to drive said motor generator and start said internal combustion engine, and;

if the voltage generated by said motor generator is greater than charging voltage of said main battery, voltage step-down control is performed by a step-down chopper circuit to step down said voltage until it agrees with the charging voltage of said main battery.

28. (new) A motor generator control method for a hybrid car according to Claim 27 characterized in that, in the startup operation by said motor generator, the current phase of a stator winding is controlled by an inverter to get strong field current component whereby said internal combustion engine is started.



29. (new) A motor generator control method for a hybrid car according to Claim 27 characterized in that;

said motor generator is a permanent magnet synchronous motor generator or jaw type magnetic pole synchronous motor generator;

when said internal combustion engine is started, strong field control is made by the inverter until the rotational speed requiring the maximum torque is reached, and, at the same time, the step-up chopper circuit is operated to make motor-applied voltage greater than the battery voltage and to get the motor current to have a specified current value, thereby obtaining the maximum torque; and

when torque assist function is used until a high rotational speed is reached, weak field current component control is performed through control of the current phase of said stator winding, and, at the same time, the step-up chopper circuit is operated to increase the motor applied voltage so that the motor current is kept at the minimum.

30. (new) A motor generator control method for a hybrid car according to Claim 25 characterized in that;

said motor generator is a permanent magnet synchronous motor generator or jaw type magnetic pole synchronous motor generator;

when power is generated by said motor generator after start of said internal combustion engine is started, stator winding current phase is controlled to get strong field current component if the internal combustion engine speed is close to idling speed;

then with the increase in internal combustion engine speed, the current phase of said stator winding is controlled to get strong field current component, thereby keeping generation voltage at the level of charging voltage; and

with further increase in engine speed, generation voltage is stepped down by the step-down chopper circuit with the state of weak field current component kept unchanged, and voltage control is made to ensure that generation voltage agrees with battery charging voltage.

31. (new) A motor generator control method for a hybrid car according to Claim 27 characterized in that;

said motor generator is an induction motor generator;

when said internal combustion engine is started, the current phase of said stator winding is controlled so that strong field control component is obtained until the rotational speed requiring the maximum torque is reached, and at the same time, the step-up chopper circuit is operated to make motor-applied voltage greater than the battery voltage, thereby obtaining the maximum torque even if the stator

winding current is small at the time of internal combustion engine startup; and

when torque assist function is used until a high rotational speed is reached, weak field control is performed, and, at the same time, the step-up chopper circuit is operated to increase the motor-applied voltage, thereby obtaining the assist torque.

32. (new) A motor generator control method for a hybrid car according to Claim 27 characterized in that;

when said motor generator is started by said battery power, a step-up chopper circuit is installed on the output side of said battery and the conversion voltage ratio of said battery voltage is set at 1.5 times or more, to ensure that the current capacity of the switching element of said inverter main circuit is smaller than that of the switching element of said step-up chopper circuit.

33. (new) A motor generator control method for a hybrid car according to Claim 25 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

34. (new) A motor generator control method for a hybrid car according to Claim 26 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

35. (new) A motor generator control method for a hybrid car according to Claim 27 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

36. (new) A motor generator control method for a hybrid car according to Claim 28 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it

agrees with the charging voltage of said main battery is reached.

37. (new) A motor generator control method for a hybrid car according to Claim 29 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

38. (new) A motor generator control method for a hybrid car according to Claim 30 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

39. (new) A motor generator control method for a hybrid car according to Claim 31 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a



light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.

40. (new) A motor generator control method for a hybrid car according to Claim 32 characterized in that said battery comprises a auxiliary battery of 14-volt charging voltage as a light source for a lamp or the like, and a main battery of 42-volt charging voltage;

said internal combustion engine is started by the electric power supplied from said main battery through said motor generator;

power is generated by said motor generator through rotation from said internal combustion engine, thereby charging the main battery; and

the battery is charged by operation of said motor generator in the generation mode using the power of the internal combustion engine after said internal combustion engine has started;

wherein, if the generation voltage of said motor generator is greater than the charging voltage of said main battery, voltage control is performed to step down the generation voltage through said step-down chopper circuit so that it agrees with the charging voltage of said main battery is reached.